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E P I T O M E
OF A
COURSE of LECTURES,

ON THE FOLLOWING SUBJECTS,

In the Mathematics, and in Natural and
Experimental Philosophy ; *viz.*

ASTRONOMY,	HYDROSTATICS,
DIALLING,	LAND SURVEYING,
ELECTRICITY,	MATTER and MOTION,
FORTIFICATION,	MECHANICS,
GEOGRAPHY,	NAVIGATION,
GEOMETRY,	OPTICS,
HYDRAULICS,	PERSPECTIVE, and
HYDROGRAPHY,	PNEUMATICS.

By W. GREEN, *K*
At his Academy, N^o 71, HIGH-STREET,
MARY-LE-BONE.

L O N D O N :

Printed in the Year 1782.



ADVERTISEMENT.

THIS Course of Lectures, in the Mathematics and Natural and Experimental Philosophy, will comprehend a general Knowledge of the material World; the Laws which the Deity has prescribed to Nature in all her Works will be experimentally proved, with a good Apparatus of new and curious Instruments and Machines, and clearly demonstrated by many mathematical Figures, Projections, Plans, and Maps, drawn with the greatest Accuracy and Neatness; intended as the Basis or Foundation of the most useful Knowledge; illustrated and explained in an engaging Manner, so as to assist the Youth of both Sexes in a rational Enquiry into the Works of the omnipotent Creator, whereby their Ideas of his Attributes and Perfections may be much enlarged and enlightened.

4 ADVERTISEMENT.

The more familiar Experiments, which relate to the necessary Concerns of Life, will be particularly dwelt upon and explained, which will render them useful to young Gentlemen who are intended for the Service of the Army or Navy, for Engineers, Surveyors, Mechanics, &c.; and although they should not be designed for Adepts in Philosophy, yet it may be presumed that there will be many new Experiments and Observations interspersed, which may be worthy of their Notice. The Lecturer only hopes, that while he instructs and improves the less enlightened Part of his Audience, he shall meet with the Approbation of the more learned. The Experiments on the various Machines, to elucidate the general Heads of each Lecture, are not all separately mentioned, as they will be occasionally varied in the different Lectures, and new ones frequently substituted, as the Sciences advance towards Perfection.

*The Lectures begin at Eleven o'Clock in the Morning, Twice a Week, till the Whole
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are finished; Two Hours Attendance to each. Every Subscriber pays a Guinea for the whole Course, which consists of Twelve Lectures, and will begin at any Time when Thirty have subscribed. Admittance a single Person, Half a Crown.

There will also be an Evening Course of Lectures on the same Plan as the Morning Course.

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LECTURE

LECTURE I.

ON MATTER, MOTION, MECHANICS,
&c.

KNOWLEDGE may be divided, philosophically speaking, into absolute and relative—both defined.—A short Dissertation on Causes and Effects—and on the five Senses.—Mathematics and Natural Philosophy the true relative Knowledge, and supereminent to all others, consequently highly worthy of the Attention and Cultivation of all Mankind.—The visible Creation briefly explained.—The Solar System, on Sir Isaac Newton's Principles.—On the Fixt Stars and Comets.—Reflections on the Bodies which compose the different Systems in the Universe, arising from the preceding Explanations.—Of the original Particles of Matter, their Properties and Powers.—Of the four Elements.—Of Attraction, of Cohesion, of Expansion by Heat and Fire.—Of the Divisibility of the Particles of Matter.—
Of

Of electrical Attraction and Repulsion.—
 Of specific and elective Attractions, as the
 Basis of Chemistry.—Of Magnetism.—
 Of Gravity and projectile Force.—The
 Laws of Motion explained.—Of com-
 pound Motion.—The Line that a Body
 describes, when acted upon by two Forces.
 —Centripetal and centrifugal Force.—
 That these Forces retain the Planets in
 their respective Orbits.—That all Bodies
 on the Earth's Surface attract and are at-
 tracted by it.—On the Descent of Bodies.
 —Upon these Principles depends the
 Knowledge of Mechanics.—The various
 mechanical Powers shewn; the different
 Kinds of Levers, the Wheel and Axle,
 the Pulley, the inclined Plane, the Wedge,
 and the Screw.

LECTURE II.

GEOMETRY, TRIGONOMETRY, &c.

A Knowledge of the Elements of Geometry and Trigonometry very necessary as a Ground-work, not only for understanding these Lectures, but also as a proper Foundation for all Arts and Sciences.—Their Application to the Arts of Fortification, Land and Timber Measure, Mechanics, Gauging, Dialling, Perspective, Navigation, Architecture, &c.—The Definition of geometrical Lines, Figures, Superficies, and Solids.—Use of the Scale and Compasses—with the Manner of performing some Problems, and demonstrating some Theorems in Geometry and Trigonometry.—Mensuration of Superficies and Solids.—How to find the solid Content of any Piece of Timber, of what Form soever.—How to find the Content, in solid Inches, of any Vat, Cooler, Wine, Ale, or Beer Cask, and to calculate how many Gallons they contain.—How the Powers

Powers of mechanical Machines are calculated.

How to measure the Area of a Field, and to calculate the Number of Acres it contains.—Description of a new Instrument and Method, of the Lecturer's Invention, for measuring any Distance at one View, in order to facilitate Land and County surveying.—Description of the several Parts of a Fortrefs in Fortification, with some Maxims relating to the fortifying of Towns, Citadels, &c.

The dialling Sphere explained, with the Method of constructing horizontal and vertical Dials.

Perspective, shewing how the Points of Sight and Distance are ascertained, horizontal Line, &c.

LECTURE III.

GEOGRAPHY.

A Physical Account of the first Formation of the Earth, as well as of the Planetary System.—The Time of the Existence of the World, and the Period of its final Dissolution, according to the Hypothesis of the celebrated *Mons. de Buffon*.—An Illustration of the Earth's Motions; its annual and diurnal Revolutions; its Figure, as ascertained by the Theory of *Newton*, and by mathematical Demonstration, and likewise by Experiments made with Pendulums on different Parts of its Surface.—A geographical Description of the Earth, with its natural and political Divisions.—Present State of the Science of Geography; Suggestions for the Improvement of it, and for the studying of it with Propriety.—Changes that have happened, and are continually taking place on its Surface.—Its internal Structure, with the Depth of the various Strata;

Strata, as far as they have been traced by human Observation.

Description of the artificial terrestrial Globe of the newest Construction.—The several Circles described, as they are represented on it.—The Quadrant of Altitude.—The Mariners Compass.—The different Spheres, with the Names of their Inhabitants.—Several of the most useful and entertaining Problems performed on the terrestrial Globe.—Description of Maps and Charts.

LECTURE IV.

HYDROGRAPHY, HYDROSTATICS, &c.

THE Science of Hydrography, which treats of Water in general.—Description of Water, as a Fluid surrounding the Earth.—Its various Depths in the Ocean, Seas, &c.—Its Properties and Effects, from which the Science of Hydrostatics is derived.—The Pressure of Water upwards as much as downwards, and in all Directions.—Its Compressibility in a very small Degree.—The hydrostatic Paradox exemplified.—The hydrostatic Balance shewn.—Lead made to swim, and light Wood to sink in this Fluid.—Hydraulics is the Doctrine of spouting Fluids.—The Velocity with which Water spouts from the Sides and the Bottom of Vessels.—Method of conveying Water, by its Pressure, over Hills and Vallies, in bended Pipes, to any Height, not exceeding that of the Springs from whence it flows.—Experiments with the Syphon—its particular

cular Properties.—The common sucking and other Pumps described, with the Mode of constructing them.

The Resistance of Fluids, in Proportion to their Density.—Description of the Hydrometer.—Method of calculating the Weight of a Ship, Boat, or any other Body that swims in Water.—The Mariners Compass, with the Variation of the Needle shewn.—The Use of the Log Line at Sea.—The Use of the improved *Hadley's* Quadrant.—How to take an Observation with it; also how to find the Latitude, Longitude, Distance run, Departure from the Meridian, &c. illustrated arithmetically and geometrically.

LECTURE V.

PNEUMATICS.

THAT the Air is a thin, transparent, fluid Body, in which we live and breathe.—It is necessary to the Preservation of Life in all Animals.—Invisible for very wise Reasons ; an Idea, however, may be formed of it by the Sight, when it reflects the Sun Beams to the Eye.—Its Height above the Surface of the Earth.—Description of the Atmosphere.—Air a Body possessing Gravity, Fluidity, and Elasticity.—The Action of the Sun's Rays upon the Atmosphere, and the Reason of the extreme Cold that prevails on the Tops of Mountains, even in the Torrid Zone. The Air being made to swell with Heat, the Wind (which is nothing more than the Air in Motion) rises to restore a due Equilibrium in the Atmosphere; hence the Reason why Air rushes into a warm Room or Glass House with such Violence. The Trade Winds, Monsoons, Sea and Land

Land Breezes, the Hermattan, and Whirlwinds accounted for.—The Cause of Thunder and Lightning, and their fatal Effects.—Of the Aurora Borealis, or Northern Lights.—Of the Formation of Hail, Snow, Rain, Mists, Dews, &c. in the Atmosphere.—Of Earthquakes and Volcanoes.—Of Meteors.—Doctrine of Sound.—Its Velocity.—Sound, when reflected by Obstacles at a Distance, produces the Echo.—On the Nature of Hearing and Speaking Trumpets.

Many Experiments on the Air Pump, to shew the Resistance of the Air, its Weight, and its Elasticity.

LECTURE VI.

PNEUMATICS.

THE Height of the Atmosphere, or Body of Air encompassing the Earth, accurately measured by the Torricellian Tube or Barometer.—This Instrument described and constructed.—The Method of chusing a good one shewn.—The Reason why the Mercury rises and falls at the Approach of fair Weather and Rain, with some useful Observations.—The Thermometer exhibited, with its Use in measuring the Degrees of Warmth and Cold.—How constructed.—The Hygrometer, or Instrument for shewing the Degrees of Moisture and Dryness in any Place or Apartment.—How they are easily constructed.—On the Variety of Airs, according to the latest Discoveries.—On fixt Air, inflammable Air, nitrous Air, Air infected by Respiration, marine acid Air, alkaline Air, vitriolic and vegetable acid Airs.—How these various Kinds of Air are produced.

produced.—Their Effects described, with curious Experiments on the common, inflammable, nitrous, fixt, and dephlogisticated Airs, &c.

The Utility of our being acquainted with the different Airs, though unknown to the last Age.—The Inferences drawn by Dr. *Priestley*, concerning the noxious Air from Bodies, when left to putrefy on Land and in Water.—Mode in which the vegetable Kingdom imbibes the phlogisticated Air, and is much nourished by it.—The wise Provision made by Nature to purify the Air, and render it fit for animal Respiration, by Winds, &c.

LECTURE VII.

OPTICS.

DEFINITION of Light.—Its Particles.—Of the Rays of Light.—The Hypothesis that Light may be propagated by Pulsions or Vibrations through the ætherial Medium, is shewn to be pressed with some Difficulties.—Laws of Reflection and Refraction in different Mediums demonstrated.—The Crepusculum or Twilight explained.—The Reason why the Heavenly Bodies appear larger in the Horizon than in the Meridian.—The Angles of Incidence, Reflection, and Refraction ascertained.—The different Sorts of Lenses described—their particular Properties in refracting the Rays of Light.—The Manner of Vision.—A Dissection of the Eye, to shew the various Coats and Humours of that noble Organ.—That the Image of the Object is painted inverted rather on the Choroides than on the Retina.

tina.—Why seen upright.—The Myops, or short-sighted Eye, as also the Presbyta, or long-sighted Eye described, with the best Distance for seeing an Object distinctly.—How the Rays of Light are differently refracted in passing through the Humours of the Eye.—The Effect when they proceed from an Object and strike immediately upon the optic Nerve.—The Prism exhibited, to shew the various Colours of Light.—The Rationale of the Division of the seven primary Colours.—The Colour of White arises from a due Mixture of all the Colours.—Black no Colour at all, or a Deprivation of Colour. The Transparency and Opacity of Colours shewn, when mixt together, and separate.—Explanation of that curious Phenomenon the Rainbow.

LECTURE VIII.

OPTICS.

THE solar Microscope described and exhibited, with Variety of Objects magnified by it, and painted on the Wall opposite.—The single Microscope shewn, with Variety of Objects; and also the double or compound Microscope, with Objects.—The internal Structure of each of these Microscopes explained by Drawings, &c.—The Method of calculating the magnifying Power of each Kind.—The external and internal Structure of the reflecting Telescope, with the Description of a new Micrometer, of the Lecturer's Invention, adapted to it, for ascertaining the Quantity of a small Angle, and for taking with Accuracy the apparent Diameters of the Heavenly Bodies. — The refracting achromatic Telescope described, after the same Manner as the Reflector, with the Method of calculating the magnifying Power

Power of each, and Directions for choosing the best.—The Specula of the reflecting Telescopes, ground and polished after the parabolic Form, claim the Preference of all others, though not so easily made.—The Rationale of the Camera Obscura explained, with some curious Observations on that Instrument.—Its Utility in taking Landscapes, &c.—The Zografscope, or Glafs for looking at perspective Views or Pictures, exhibited.—The Opera Glafs, its Use, together with the interior Structure of each of these Instruments.—The common plane Mirror or Looking-glass—why it need not be more than Half as long as the Object, in order to represent the Whole.

LECTURE IX.

ELECTRICITY.

RISE and Progress of Electricity.—
 The Properties of Glass, Sealing Wax,
 Amber, Jett, &c. in attracting and repel-
 ling light Bodies.—Conductors and Non-
 conductors of Electricity.—Of positive and
 negative Electricity.—In what respects the
 electric Fire resembles Lightning, the
 common culinary Fire, and the solar
 Light.—Hypothesis deduced from hence.
 —Variety of Experiments performed by the
 Help of the electrical Machine, with Leaf
 Gold, fine Sand, and the magnetic Needle.
 —The electrical Fluid exhibited in Vacuo.
 —The Aurora Borealis.—The luminous
 Conductor. — The Thunder House. —
 Sharp-pointed Conductors the best and
 safest for conducting Lightning from the
 Tops of Houses to the Earth.—The elec-
 trical Shock—a Chain of Persons formed,
 so as to receive and feel the Shock in dif-
 ferent

ferent Parts of the Body, while some escape it.—The Shock augmented by the *Leyden Phial*.—Dr. *Franklin's* Hypothesis of its Effects on the Phial explained.—Experiments on Plants insulated, as well as on the Human Body.—Disorders in which Electricity may be applied, with the Method of doing it.—To conclude with many new and curious Experiments.

LECTURE X.

ASTRONOMY.

ON Chronology.—The Year divided, according to the Julian and Gregorian Calendars.—The Equation of Time defined.—Of Solar and Sydereal Time.—The Dominical or *Sunday* Letter explained; how to find it.—The Solar and Lunar Cycles calculated.—The Roman Indiction.—The Manner of finding the Solar, Lunar, and Indiction Cycles.—The Epact.—The Golden Number.—The Moon's Southing.—The Moon's Age.—The Time of High Water found at any Place.—The Definition and Calculation of each of these shewn.

Description of the several imaginary Circles of the Sphere.—The Axis—The Equinoctial—The Meridian—The Ecliptic, with the Signs of the Zodiac—The Equinoctial and Solstitial Colures.—The Latitude and Longitude of any Point
in

in the Heavens.—The right and oblique Ascension, and oblique Descension—Declination—Ascensional Difference—The Zenith — Nadir — Azimuth Circles — Prime Vertical — Amplitude — Meridian Altitudes, &c.

Description of the Celestial Globe.—Number of the fixt Stars arranged in Constellations—their Names and Magnitudes in the Northern and Southern Hemispheres.—Telescopical Discoveries in the fixt Stars by the Moderns.—This Lecture concludes with Variety of useful and entertaining Problems on the Celestial Globe, in which the Phenomena of the Harvest Moon will be illustrated.

LECTURE XI.

ASTRONOMY.

A Refutation of the Ptolemaic and Ty-chonic Systems not necessary at this Period of our Knowledge in Astronomy, they having been exploded for a Century past.—The *Newtonian* or Solar System explained, agreeable to Demonstration and Observation.—The Planets diurnal and annual Revolutions, together with the Satellites of *Saturn*, *Jupiter*, and the Earth.—Dissertation on Comets.—Their Number not ascertained.—Their Periods of Revolution round the Sun, according to Dr. *Halley*, and other Astronomers.—On the fixt Stars, and the Universe of Systems.—The Principles laid down in the second Lecture being well understood, it will be easy to give a Demonstration of the Solar System, by the Theory of Gravity, and *Kepler's* Problems, for shewing the periodic Time of each Planet's Revolution round the Sun, and their relative Distances.

Distances.—How the Magnitudes of the Planets are found by Micrometers fixt to Telescopes.—How the Sun's Distance from the Earth is ascertained by Observations made on the late Transits of *Venus*.—consequently the absolute Distances of all the Planets from the Sun in *English Miles*.—The direct, stationary, and retrograde Motions of the Planets illustrated, as seen from the Earth, particularly *Venus* and *Mars*.—The Seasons of the Year exhibited, as well as the Days and Nights, by the Earth's annual and diurnal Motions.—The Phases of the Moon, with the Causes of Eclipses of both Luminaries, when they happen, and how calculated.—An exact Representation of the Lunar Disc, from Telescopical Observations.—The Nature and Cause of the Tides, or Flux and Reflux of the Sea.—Of Spring and Neap Tides, caused by the Attraction of the Sun and Moon on the Earth.—Of the Tides in the Air, arising from the same Causes which affect the Waters.

LECTURE

LECTURE XII.

Recapitulation of the whole Course, in order to assist the Memory, interspersed with many new Experiments, to demonstrate the Truth of what was laid down in them.—An Explanation of the Medium, nearly answering to the Definition of Sir *Isaac Newton's* Æther, yet wanting, to account for all the Phenomena observable in Nature.—That there is such a Medium demonstrated, with some of its Properties, by curious Experiments.—That a due Reflection on the Works of Nature naturally leads us to the Enquiry of the primary Agent or first Cause.—The Being, Omnipotence, and Omnipresence of God, as living and acting in the ætherial Infinity of Space throughout the whole Universe.—That the Opinions of the ancient Fathers, Philosophers, and Poets, in all Ages of the World, confirm the omnipresent Existence of the Deity virtually and substantially.—Conjecture that the
Planets

Planets may be inhabited, reasoning from Analogy on what we see on the Earth's Surface, and what we observe on the Surface of our nearest Neighbour the Moon, assisted with the best Telescopes. — To conclude with due Reflections, worthy of Man, who sees himself at the Head of the Operations of the Omnipotent Being on the Earth, and with respect to the several Systems contained in the Universe, of which our habitable Globe is so small a Part.

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